

New Pacific Northwest Neptuneas

(Mollusca : Gastropoda : Neptuneidae)

BY

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(3 Plates)

DURING THE LAST TEN YEARS or so, specimens of large-sized carnivorous gastropods of the genus *Neptunea* have been accumulating from deep water off the coast of central California and the Pacific Northwest. The first mention of these is contained in a brief note by Robert R. Talmadge of Eureka, California, published in the Minutes of the Conchological Club of Southern California (John Q. Burch, ed.), no. 90, page 5, May, 1949. Mr. Talmadge mentions 3 species of *Neptunea* brought in by commercial otter-trawl fishermen from off Humboldt Bay in depths down to 165 fathoms, including one considered to be similar to *N. pribiloffensis* (Dall, 1919). Study of the first series of these shells obtained by Mr. Talmadge, comparison with the fine series of Neptuneas in the mollusk collection of the United States National Museum, and the subsequent availability of a considerable number of additional specimens from off Humboldt Bay and other more northern localities have left no doubt about the novelty of this large, fairly common species.

Neptunea humboldtiana A. G. Smith, spec. nov.

(Figures 1 to 4 and 5 to 13)

General Diagnosis: This light-colored, relatively short-spined *Neptunea* attains a large size for the genus and is characterized in the adult stage particularly by rounded later postnuclear whorls, deep sutures, and a tumid body-whorl; young shells have straight or somewhat sloping early whorls. The number of postnuclear whorls normally is $4\frac{3}{4}$ or 5; the canal is short. The outer lip flares widely on many adults and there is a tendency for a prominent secondary lip-flange to develop with age. Sculpture on the early postnuclear whorls consists of a few brownish colored fairly strong spiral cords, with or without finer intercalaries between them. The body-whorl of adult shells may be spirally lirate with weak spiral cords and intercalaries, or may be entirely smooth. The species occurs

most commonly in a general area roughly bounded on the south by Humboldt Bay, California, and on the north by La Perouse Bank off Cape Flattery, Washington, in depths ranging from 100 to 250 fathoms. It is related to *N. pribiloffensis*, which lives farther to the north with a range south to Queen Charlotte Sound, British Columbia.

Type Series: Twenty specimens, all with contained animals, trawled in 120 fathoms off Redding Rock, Humboldt County, California (the type locality) by the M/V *St. Joseph*, 19 January 1960, received through the courtesy of Messrs. E. G. Gunderson, Tom Jow, and Jim Thomas of the California Department of Fish and Game.

Holotype: A representative mature shell from the type series measuring: length, 132.1 mm; maximum diameter, 87.8 mm; length of aperture and canal, 83.7 mm; width of aperture, 55.5 mm. The apical angle is about 70° . It has been placed in the California Academy of Sciences Department of Geology (CASG) Type Collection, no. 13637. The animal, preserved in alcohol, is deposited in the California Academy of Sciences Department of Invertebrate Zoology (CASIZ) Type Series, no. 418.

The shell (Figure 1) is large, whitish, thin textured, with a tumid body-whorl, well-impressed sutures, a spire slightly shorter than the rest of the shell, and a short canal bent somewhat to the left but not appreciably to the rear. The aperture is capacious, subovate, light orange-yellow inside, with a widely flaring outer lip having a final growth stage extending well beyond a prominent earlier one seen from the inside. The inner lip has a heavy wash of callus appressed to the somewhat sinuate columella; there is no marked siphonal fasciole. The first 3 postnuclear whorls are nearly straight-sided; the penultimate and body whorls are rounded. The nuclear tip is broken off, the total number of postnuclear whorls being $5\frac{3}{4}$. Sculpture consists, on the first 2 postnuclear whorls, of 2 prominent spiral cords, the upper one near the whorl

periphery, the lower near the suture. The third postnuclear whorl has a nearly straight, sloping shoulder above the upper spiral cord; 3 faint intercalary riblets begin to show as this whorl increases in size. The 2 earlier heavy spiral cords become weaker on the penultimate whorl and fade out completely on the body-whorl, which is smooth except for a series of closely-spaced, subobsolete spiral lirae and the fine, irregular growth-ridges that show as an overlapping series of shell layers under a magnification of $\times 10$ (Figure 5). The shell has a dull finish; there are no vestiges of a periostracum.

Paratypes: The remaining 19 specimens from the type locality are so designated. In addition, specimens from other than the exact type locality are also designated as paratypes as these have been collected within the known range of the species, have been studied in detail, and have contributed significantly to a knowledge of it. Paratypes have been distributed among several public museums and

institutions maintaining type collections (including the California Academy of Sciences); several have been sent to private collectors, who have cooperated in supplying specimens for review.

Geographical Range; Specimens Examined: Based on an analysis of more than 100 specimens of all ages (except the nuclear stage), the range of *Neptunea humboldtiana* extends from off the Farallons, central California, to an area 40 miles off Point Estevan, central Vancouver Island, British Columbia, Canada, in depths ranging from 50 to 800 fathoms. A single, live-collected adult may have come from as far north as the southern end of Hecate Strait, the collection data being uncertain as to specific locality. For purposes of discussion, the material at hand, preserved both dry and in alcohol, has been combined into 6 fairly homogeneous groups, as shown in Table 1.

In addition to the material analyzed in Table 1, 5 adult and 6 juvenile shells from a series of 36 from 225 fathoms

Table 1
Distribution and Numbers of Specimens

Group	Depth range (fathoms)	Locality	Numbers of Specimens Measured		
			Adults	Others	Total
A	50	Off the Farallones and Bodega Head, California	1	2	3
B	50-120	Off Humboldt Bay, Humboldt Bay, California	9	2	11
C	150-250	Off Humboldt Bay, California (Redding Rock, Patrick's Point, etc.)	26	18	44
D	50-225	SW of the mouth of the Columbia River, northern Oregon	4	9	13
E	300-800	SW of the mouth of the Columbia River, northern Oregon	4	10	14
F	50-150	Vicinity of La Perouse Bank, Washington, to Point Estevan, British Columbia	9	10	19
Total specimens:			53	51	104

Plate Explanation

Neptunea humboldtiana A. G. Smith, spec. nov.

Figure 1: Holotype. California Academy of Sciences Geology Type Collection, no. 13637. Apertural view. Length, 132.1 mm; maximum diameter, 87.8 mm; $5\frac{3}{4}$ whorls.

Figure 2: Adult shell lacking major spiral cords but having many closely-spaced spiral lirations. Paratype. Walter J. Eyerdam Collection. Rear view. Length 131.7 mm

Figure 3: Adult shell with outer lip doubled. Paratype, CASG Type Collection, no. 13638. Length, 127.5 mm. Apertural view.

Figure 4: Apertural view of another adult shell with unworn sculpture and a complete nuclear whorl. Paratype, CASG Type Collection, no. 13640. Length, 132.7 mm.



Figure 1



Figure 2



Figure 3

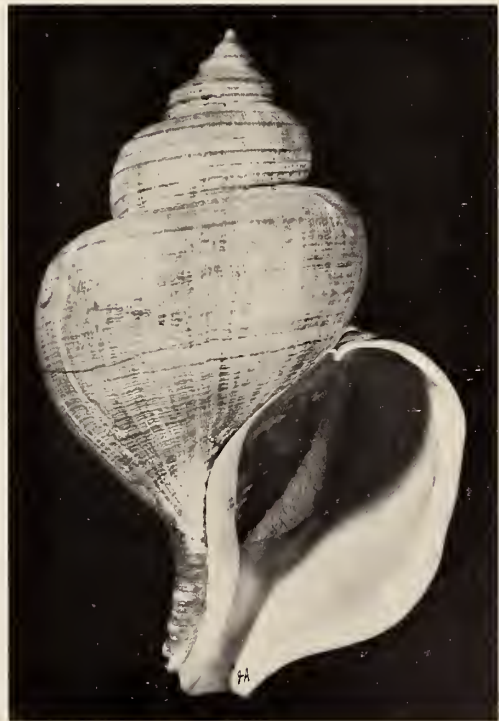


Figure 4



off Brookings, Oregon, and 13 shells from a series of 150 from 100 to 200 fathoms off Humboldt Bay, obtained by Mr. Ralph Ferguson from commercial fishermen, have been studied and returned to him.

Nearly half of the specimens of *Neptunea humboldtiana* have been trawled by fishermen working the area off Humboldt Bay for various species of sole (Group C, Table 1). This is the area selected as the type locality where shells generally are of large size and well developed when adult. However, it is obvious from a series trawled by the R/V *N. B. Scofield*, operated by the California Department of Fish and Game in fisheries investigations, that the species does occur in shallower water in the same area (Group B, Table 1), although adult shells are somewhat smaller.

Two small specimens that can be identified properly as *Neptunea humboldtiana* have been taken as far south as the Farallons, about 20 miles off the central California coast opposite San Francisco Bay; another was dredged in 300 fathoms on green mud NNW of Bodega Head by the USS *Albatross*. The species did not turn up in the trawling operations of the R/V *N. B. Scofield* off the coast of Mendocino County, although Mr. Talmadge reports it as having been collected off Fort Bragg; it was not encountered until the *Scofield* reached the vicinity of Humboldt Bar in Humboldt County. Consequently, the Farallon area may not represent the normal southern end of the range of the species.

Except for the series of shells obtained by Mr. Ferguson from off Brookings, Oregon, and others in the Talmadge Collection from 150 fathoms off Cape Arago and off Yaquina Bay in central Oregon, the next sizable group of specimens at hand comes from an area to the southwest of the mouth of the Columbia River, northern Oregon, in depths of 50 to 800 fathoms. These were collected by the United States Bureau of Fisheries, A. E. C. Project, using R/V *Commando*, with one lot obtained by the R/V *John N. Cobb*; most were live-taken and have been preserved in alcohol with the contained animals (CASIZ Collection). This series of shells divides about equally between those from depths of 50 to 225 fathoms (Group D, Table 1) and those from 300 to 800 fathoms (Group E, Table 1), the latter from depths far exceeding any attained so far by West Coast commercial trawlers. The Neptuneas obtained by the *Commando* in this area also include a small series of juvenile specimens close to, or conspecific with, *Neptunea stilesi* A. G. Smith, 1966, and 2 small series of *N. amianta* (Dall, 1890). Contrary to the situation off the Humboldt Bar, shells from deeper water off the mouth of the Columbia River are smaller in size.

The northern part of the range of *Neptunea humboldtiana* is in the vicinity of La Perouse Bank, about 40 miles

off Cape Flattery, Washington. This is the general area worked by commercial trawlers operating out of Bellingham, Puget Sound, Washington, from whom shells have been obtained through cooperation with Walter J. Eyerdam of Seattle and the late Everett C. Stiles of Bellingham. Adult specimens are not appreciably different in size from those living farther south. Except for a single shell said to have come from the southern end of Hecate Strait, the northernmost record for the species is based on an adult, typical specimen taken in 75 fathoms off Point Estevan, central Vancouver Island, by Karl W. Kenyon of the United States Fish and Wildlife Service (Paratype, CASG Type Collection, no. 13638).

Individual Variation: For purposes of comparison, measurements and notes were recorded for a total of 53 more or less perfect adult shells of *Neptunea humboldtiana*. These consisted of a count of the total remaining postnuclear whorls to the nearest $\frac{1}{4}$ volution; and the over-all shell length, maximum diameter, maximum length of the aperture and canal measured directly (*i. e.*, not parallel to the shell axis), and the maximum width of the aperture taken from the outside surface of the outer lip to the edge of the wash of callus forming the inner lip. Because many adult shells had the outer lip broken or damaged to the extent that some of the measurements would be inaccurate, such shells were not measured. Likewise, dimensions of juveniles and subadults were not taken, as these would not provide additional significant data. A summary of the variation between various measurements by groups in Table 1 is given in Table 2. The longest adult shell at hand (135.7 mm) is in the type lot from 120 fathoms off Redding Rock, Humboldt County, California (Paratype, CASG Type Collection, no. 13639; animal in CASIZ Type Series, no. 419). The longest known shell (144 mm) is in the Talmadge Collection. The shortest adult shell (72.7 mm) comes from 325 fathoms off the mouth of the Columbia River, northern Oregon (Paratype, shell and animal, CASIZ Type Series, no. 420).

Number of Whorls: The thinness of the shell structure of *Neptunea humboldtiana* is notable. For their size, no other Neptuneas from the West Coast of North America are nearly as light in weight. Thus, the shells are broken easily, especially if they have not developed appreciably thickened outer lips. This factor also contributes to the loss of the nuclear tip and one or more of the early postnuclear whorls, making an accurate whorl count difficult to obtain. Only 2 of all adult specimens examined retain perfect, unworn nuclear whorls (Figure 4). These are 2 in number, smooth, erect, nearly straight-sided,

white, and somewhat chalky (Figures 7, 8). The postnuclear whorls on adult shells range from about 4 to $6\frac{1}{4}$; the most frequent number is $4\frac{3}{4}$ for 10 shells, followed by 5 whorls for 7, and $4\frac{1}{4}$, $4\frac{1}{2}$ and $5\frac{1}{2}$ on each of 6 shells. Only 3 of the total of 52 adults have 6 or more postnuclear whorls.

Outer Lip Characteristics: *Neptunea humboldtiana* is remarkable for its globose body-whorl and its capacious aperture. The latter is enlarged by a tendency for the animal to develop a widely flared outer lip on reaching maturity and then, as it grows older, to increase the thickness of the outer lip and the canal by adding new shell layers. More remarkable, however, is the further tendency to develop a complete new second, separated outer lip flange (Figure 3). Out of the total of 52 adult shells available, 13 have the outer lip doubled in this manner, occasionally with an accompanying doubling of the tip of the canal. A thickening or doubling of the canal shell layers often creates a narrow but well-developed siphonal fasciole. In older shells, also, there is often a thickening of the inner lip making the peritreme complete, and occasionally forming a small lip-notch at the top of the aperture.

Canal: This is quite short compared with the rest of the shell in all adults. There is some variation in configuration, those on some shells being straight while on others they are bent slightly to the left or to the rear, or both.

Sculptural Variation: The major spiral cords on all shells are more keel-like on the early postnuclear whorls (Figure 6), becoming lower and more rounded on the later whorls, and often disappearing completely on the body-whorl. On many shells the major spirals are widely spaced and range from pinkish brown to dark brown in color, contrasting with the whitish or extremely light brownish ground color of the rest of the shells. The variation in

spiral sculpture on adult shells can be described by referring to 3 general types that differ in the numbers and strength of the intercalary lirations. In one type the major spirals are 2 in number on the first and second postnuclear whorls, with a weak third below the other 2 developing on the third postnuclear whorl; the penultimate whorl has 3 well-marked spirals below the upper, and 2 even weaker ones below the lower; there are 2 and sometimes 3 faint intercalaries between and below the major spirals. The body-whorl has about 12 brown-colored major spirals with indications of some faint intercalaries between them.

A second type of sculpture has about the same general aspect as the first, but with 4 to 6 rapidly developing, strong intercalaries between the major spirals. To the unaided eye, shells with this type of sculpture are noticeably spirally lirated all over. A third, less frequently seen type is represented by 2 shells from the northern end of the range, in which the major spirals are much less evident but with many, closely-spaced, strong spiral lirations covering the entire surfaces of the later postnuclear and body whorls (Figure 2).

The Animal: Living animals of *Neptunea humboldtiana* have been observed by Mr. Talmadge, who has kindly permitted me to use his detailed notes. He says the body of the animal has a pale greenish-cream color heavily maculated with small, irregular, dark-brown blotches, which decrease in both number and size toward the edge of the foot. The tentacles and siphon are maculated also, the sole of the foot having a light tan or orange tint when seen crawling on a glass sheet (animals in alcohol retain some of the orange-yellow color and the dark maculations). The shell is carried well back over the tail, exposing the forward part of the body, head, and the broadly tapering tentacles during locomotion (Figure 12). The operculum is on the right side of the extended body and may be wholly or partially covered by the shell.

Plate Explanation

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Figure 5: Enlarged view of incremental sculpture of holotype (Figure 1), showing overlapping series of shell layers.

Figure 6: Apertural views of three juvenile paratypes. CASG Type Collection, nos. 13643 - 13645. Lengths (from left), 25.9, 30.4, and 51.2 mm respectively.

Figure 7: Enlarged back view of nuclear whorl of paratype shown in Figure 4.

Length, nuclear whorls only, 3.7 mm

Figure 8: Enlarged front view of a complete nuclear whorl on another adult shell. Paratype, CASG Type Collection, no. 13641. Length, nuclear whorls only, 4.3 mm.

Figure 9: Section of radula from animal in type lot. Central tooth with 2 cusps. California Academy of Sciences Invertebrate Zoology

Type Series, paratype no. 418; slide no. 365. Width of radula, 1.6 mm.

Figure 10: Same. Central tooth with 3 cusps. CASIZ Type Series, paratype no. 421; slide no. 366. Width, 1.5 mm.

Figure 11: Same. Central tooth with 4 cusps. CASIZ Type Series, paratype no. 422; slide no. 367. Width, 1.5 mm.

Figure 12: Shell from type locality with animal modeled in clay to show normal forward progression. White arrow indicates point of contact with substrate where shell area shows greatest wear in adult specimens.

Figure 13: Dead shell with egg capsules. From 270 fathoms off Trinidad, Humboldt County, California. CASIZ Type Series, paratype no. 423. Length of shell, 76.3 mm.

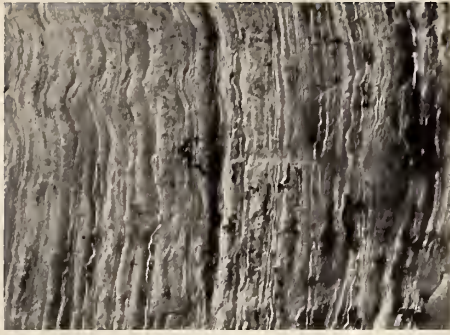


Figure 5



Figure 6



Figure 7



Figure 8



Figure 9



Figure 10

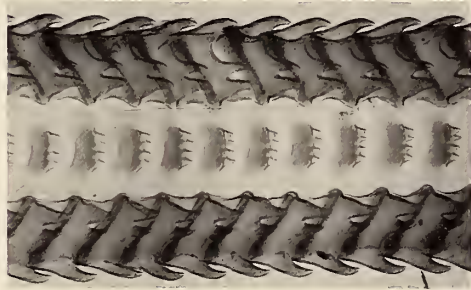


Figure 11



Figure 12



Figure 13

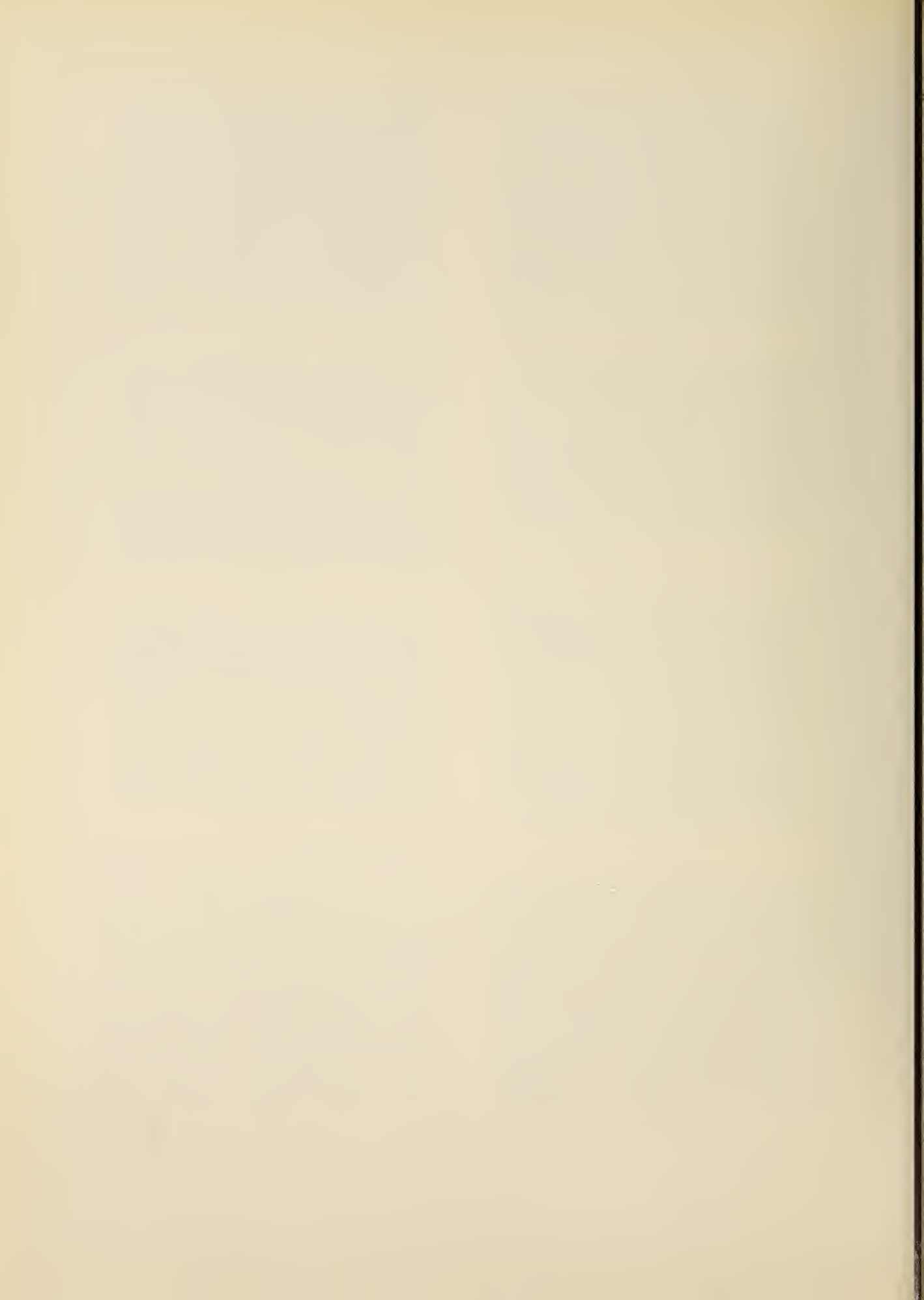


Table 2
Measurements of *Neptunea humboldtiana*

Item	A	B	C	D	E	F	Over-all
Number of adult shells:	1	9	26	4	4	9	53
Depth (fathoms):	300	50-120	150-250	50-225	325-800	50-150	50-800
Length (mm):							
Range	83	98.1-124.6	101.8-135.7	96.8-119.0	72.7-97.4	110.1-132.7	72.7-135.7
Average	83	96.1	120.1	106.6	84.1	121.3	111.8
Length of aperture and canal (mm):							
Range	50.6	60.5-74.5	66.1-83.7	65.3-78.7	45.6-60.1	64.3-83.2	45.6-83.7
Average	50.6	68.9	76.3	70.9	52.8	77.6	72.6
Maximum diameter (mm):							
Range	51.3	60.9-77.2	62.7-87.8	60.4-78.5	44.8-55.3	66.2-85.7	44.8-87.8
Average	51.3	69.9	77.3	70.7	49.6	79.5	73.2
Width of aperture (mm):							
Range	29.0	34.1-50.2	33.6-55.6	38.0-45.0	24.4-32.8	33.7-48.6	24.4-55.6
Average	29.0	39.8	45.4	40.2	27.7	44.1	42.2

As can be seen in the illustration, an area of the body-whorl just outside the inner lip is in contact with the substrate during forward progression, wearing it smooth, and in some older shells thinning it to the extent of developing a hole clear through the shell.

Operculum: There is little variation in configuration. The flexure noted on the operculum of the holotype is a consistent feature. The curving lines of growth generally are strong, beginning with the nucleus at the lower end; some opercula have faint longitudinal striae spreading upward from the nucleus.

Radula: This is typical for the genus. The variation is mainly in the number of denticles on the central tooth, which ranges from 2 to 4 (Figures 9 to 11). The radulae with 2 and 3 denticles on the central tooth, as illustrated here, were both from females from the type lot with about the same sized shells. Comparison with the radulae of other West American *Neptuneas* provide little, if any, basis for species differentiation.

Sex: My determination of the sexes of available animals, combined with similar observations by Mr. Talmadge, indicate about an even distribution between males and females. No sexual dimorphism in the configuration and the sculpture of the shells is apparent.

Habitat: According to information furnished Mr. Talmadge by otter-trawl fishermen working the area in the

general vicinity of the type locality off Humboldt Bay between Trinidad and Redding Rock, there is a more or less gentle slope to the bottom starting with a depth of 25 fathoms down to more than 300 fathoms – the slope paralleling a line 335° - 340° True. In the shallower depths the bottom chiefly is gray sand, which merges into gray or green muddy sand, then into sandy mud, and finally into nearly pure mud below the 200 fathom line. Most specimens of *Neptunea humboldtiana* have been trawled in 100 to 150 fathoms where the substrate is a combination of mud and sand. Bottom conditions toward the northern end of the range are not known to me.

Behavior: Living snails obtained by Mr. Talmadge soon after they were brought in by the fishermen became active when placed in a 5-gallon capacity plastic bucket of aerated seawater. The amount of light (daylight, artificial light, or complete darkness) did not inhibit activity to any observable extent. Movements above the water to create distinct shadow patterns had no effect, but rapid movement of a hand under water inside the bucket caused the animals to retract partially. Unfortunately, the snails did not remain active much more than 3 days, probably due to a lack of good aquarium conditions, including adequate control of temperature within the limits to which they were accustomed.

Eggs and Egg Capsules: Mr. Talmadge records the receipt of egg masses with capsules containing fresh em-